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RADIOLOGICAL EVALUATION PLAN
ROCKAWAY BOROUGH WELL FIELD
ROCKAWAY BOROUGH, NEW JERSEY

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A. Site Background (USEPA86)

The Rockaway Borough Well Field site is located in Rockaway Borough, Morris County, New Jersey (see Figure 1). The site consists of three municipal supply wells which are in a glacial aquifer designated by the EPA as the sole source aquifer for Rockaway Borough and the surrounding communities. The Rockaway Borough Water Department currently operates the well field and treats the water supply by activated carbon adsorption.

The site is located in a suburban residential setting and is surrounded by homes, businesses and municipal property. The wells are set within the Upper Rockaway watershed and provide water service to approximately 11,000 people in Rockaway Borough and portions of neighboring Denville and Rockaway Townships. In addition, Rockaway Borough sells water to Rockaway Township for distribution within its own system. High concentrations of tetrachloroethylene (PCE) and trichloroethylene (TCE) have been detected in the aquifer since 1980.

Volatile organic contamination was detected in the municipal wells in Rockaway Township in 1979. These findings prompted the New Jersey Department of Environmental Protection (NJDEP) to test the water quality in neighboring areas. Samples taken in 1980 found contamination in three of Rockaway Borough's municipal supply wells and at points within the Borough's distribution system. Concentrations of PCE up to 678 ppb and TCE up to 172 ppb were identified in the well water along with lesser concentrations of 1-1-1-trichloroethane (TCA), trans-1-2-dichloroethylene (DCE), toluene, methylene chloride, chloroform, trichlorofluoromethane, carbon tetrachloride, benzene, chlorobenzene, 1-1-DCE, bromodichloromethane, and 1-1-2-TCA.

Water samples collected from various points in the Borough water distribution system before water treatment was implemented roughly followed the trends observed in the well samples. PCE concentrations fluctuated over time between 6 and 473 ppb. Contaminant concentrations in untreated water samples peaked during 1984, when PCE concentrations rose to approximately 473

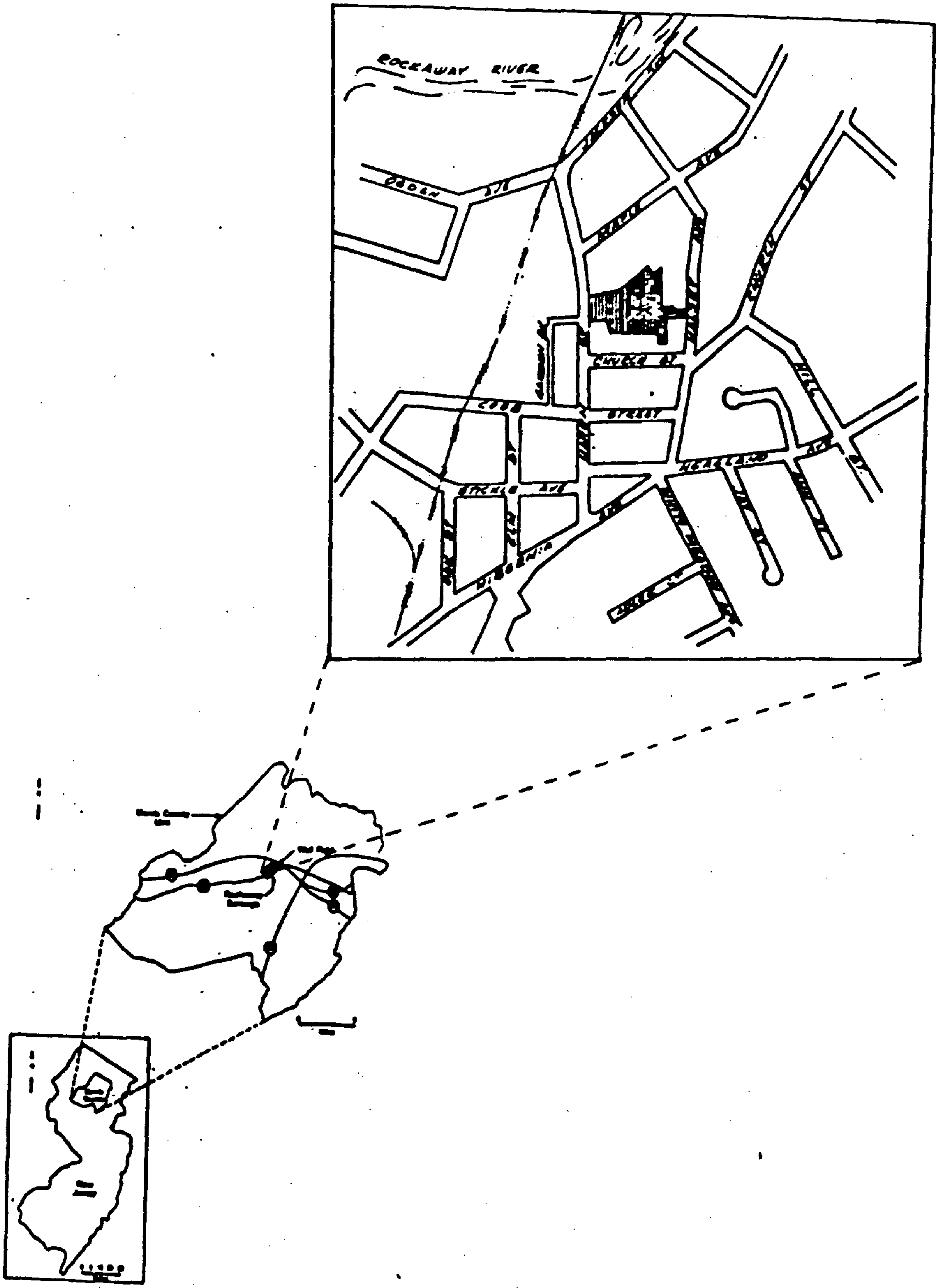


FIGURE 1. Rockaway Borough Well Field location.

ppb. As observed in the well samples, TCE was consistently present, varying between 2 and 89 ppb.

The Borough of Rockaway constructed a three-bed granular activated carbon adsorption system which began treating raw water pumped from the Borough wells in July 1981. The water emergency was lifted when chemical testing indicated that total concentrations of volatile organic compounds had been reduced to levels below 100 ppb, the limit established by the State of New Jersey.

The site was listed on the NPL in 1982, and an RI/FS was initiated in 1985. The results of the RI/FS for the site and the ROD (September 1986) indicated that the most appropriate and cost-effective means of providing safe, potable water to meet relevant and appropriate standards was the continued operation of the Borough's existing filtration system. The recommended alternative included continued operation of the existing carbon treatment unit for 1.26 mgd of contaminated groundwater, which represents the average rate of potable water distribution. The recommended alternative was designed and constructed to allow flexibility as to which wells to treat to permit optimization of pumping strategies. The carbon treatment system was designed to achieve removal of both TCE and PCE to 5 ppb for water with influent VOC concentrations based on the highest concentrations of contaminants detected individually in each of the wells to be treated plus a safety factor.

The general layout of the treatment system is shown in Figure 2, and a schematic of the GAC system is present in Figure 3. Groundwater from the well field is distributed equally into the three GAC contactors (Ma88). As the water leaves the GAC contactors it is again put back into one common header, chlorinated, and then discharged into the fiberglass ground reservoir. The treated water in the ground reservoir is then pressurized and discharged into the distribution system via three high lift booster pumps. Each of the three GAC contactor vessels (10' dia x 20' ft.) contains approximately 20,000 lbs of GAC; the empty bed contact time at plant design capacity of 1650 gpm is greater than 15 minutes. The current treatment rate averages 1 mgd (Ro88). Initially, the beds were back-flushed monthly with discharge to a storm sewer, but this practice was found to be detrimental to both treatment efficiency and the longevity of the carbon beds and has been discontinued. The carbon is changed approximately every 12 to 18 months by the vendor, Calgon Corporation, and the spent carbon is removed from the site by Calgon for regeneration.

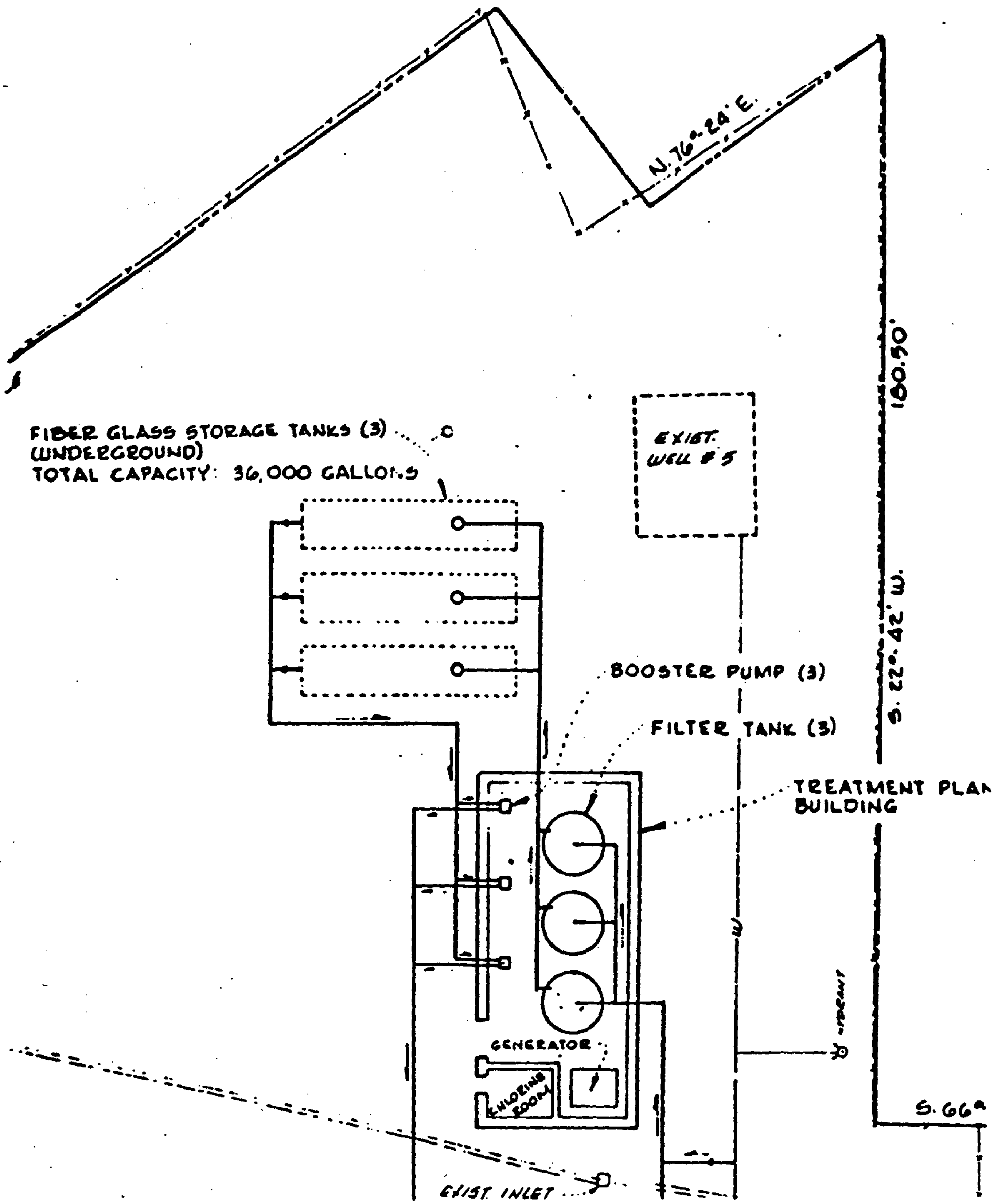


FIGURE 2. General layout of Rockaway Borough Well Field groundwater treatment system.

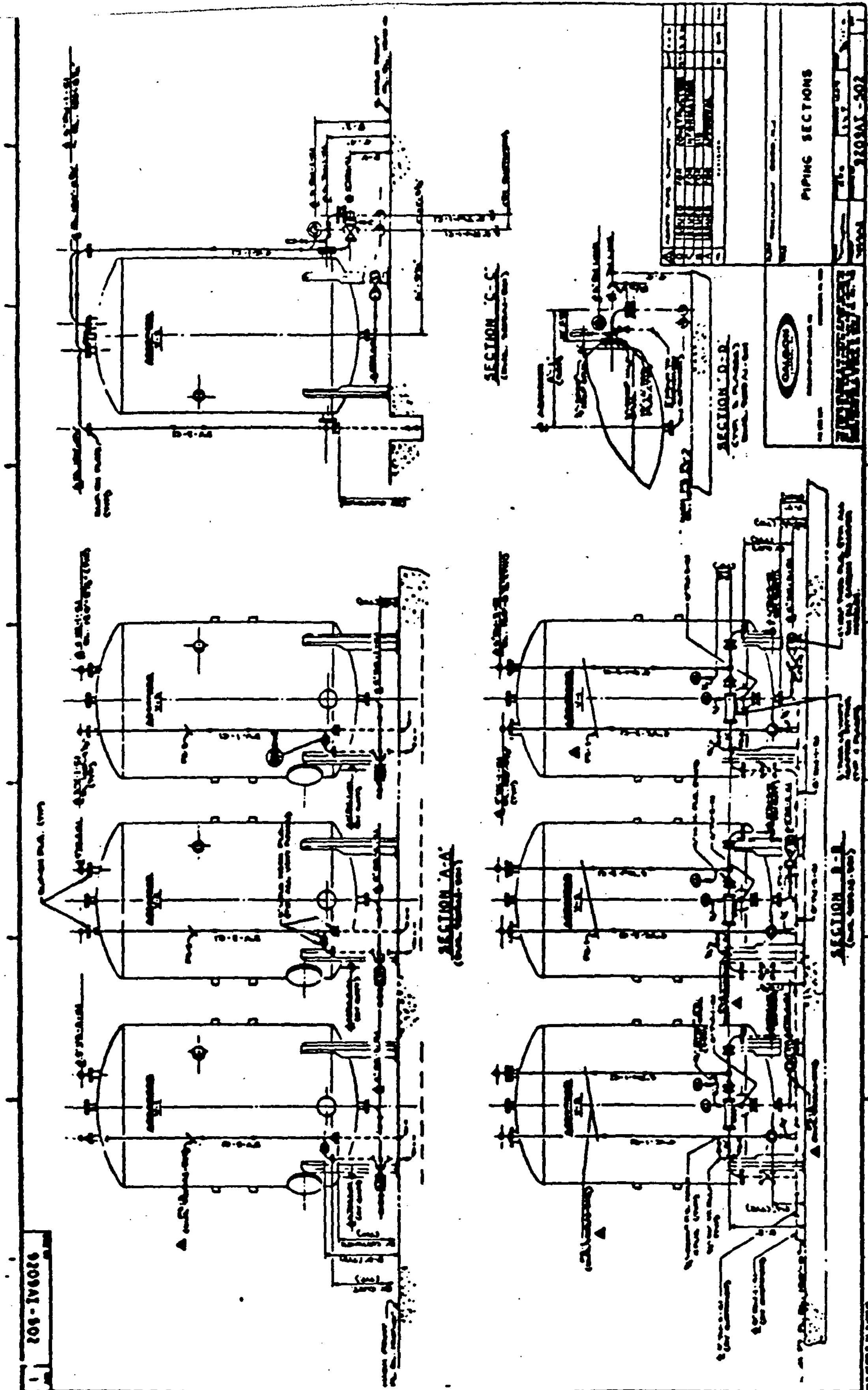


FIGURE 3. Schematic diagram of Rockaway Borough Well Field GAC treatment system design.

B. Estimates of Maximum Potential Radiation Exposures

Typical concentrations of radium in New Jersey groundwater are <1-6 pCi/L (EERF), while uranium concentrations are typically <1 pCi/L (Dr81). Concentrations of Rn-222 in Rockaway drinking water have been observed in the range 150-2900 pCi/L (Pa87), while concentrations of 1000-50,000 pCi/L have been observed in nearby communities (EERF, Pa87).

Assuming an average treatment rate of 1 mgd, a carbon changeout frequency of once per year, and an average Rn-222 concentration of 3000 pCi/L, the maximum activity potentially accumulated in the GAC beds would be:

Radionuclide	Activity (pCi)
Rn-222	6.26E+10
Po-218	6.26E+10
Pb-214	6.26E+10
Bi-214	6.26E+10
Po-214	6.26E+10
Pb-210	1.91E+9
Bi-210	1.87E+9
Po-210	9.98E+8

If the total activity is assumed to be distributed equally among the three GAC units, the maximum potential unshielded dose equivalent rate from any unit at 1 meter from the carbon surface under these conditions would be approximately 30 mrem/hour, and the dose equivalent rate outside the GAC unit would be approximately 7 mrem/hour, above the proposed action level of 2 mrem/hour; the maximum potential unshielded dose equivalent rate 30 days after these GAC units are removed from service would be about 0.8 mrem/hour with about 0.2 mrem/hour outside the unit. These estimates of dose equivalent rate are based upon the very conservative assumption of a point source; since the activity in the carbon beds would be dispersed throughout approximately 60,000 pounds of carbon among the three adsorbtion units, actual dose equivalent rates would be expected to be much lower due to self-shielding.

The total activity concentration in the spent carbon immediately after being taken off-line would be about 240 pCi/g, well below the 2000 pCi/g criterion for classification as LLW, and the activity would further decline to about 60 pCi/g within 30 days; therefore, no special restrictions on transportation or disposal should be required.

C. Radiological Evaluation Plan

In order to better characterize potential radiation exposures at the site, a radiological survey will be performed. The three GAC adsorption units at the Rockaway Borough Well Field are housed within a small treatment plant building as shown in Figure 2; the radiological survey of the site will focus upon the measurement of radiation exposure rates within this treatment building. Additional information which may be collected during the survey, especially if elevated exposure rates are observed during the initial survey, include samples of the influent and effluent water streams and samples of the spent carbon.

Due to the small size of the treatment plant building and the extensive piping within the building, personnel should be cautioned about potential physical (e.g., tripping and falling) hazards. Protective equipment for the survey personnel should include hardhats, coveralls, steel-toe boots, and TLD badges. These and other health and safety guidelines will be documented in a Health and Safety Plan for the site, and all personnel will carefully review the plan before entering the site.

Indoor Gamma Survey of the Treatment Plant Building

A radiological survey of the treatment plant building will be performed using a portable sodium iodide (NaI) survey meter. When correlated to pressurized ionization chamber measurements, exposure rate measurements with a NaI detector provide useful data on gamma radiation field strengths. This survey will be used to identify any areas of elevated exposure levels and to establish levels of personnel protection. This procedure does not provide a means to quantify the amount of radioactivity present in terms of a pCi/gram measurement. It does provide an exposure rate measurement (uR/hour) and can suggest areas that require further investigation or laboratory analysis of materials.

Equipment to be used in the radiological survey will include the following:

- Reuter Stokes Model RS-111 pressurized ionization chamber (PIC/NaI correlation data may be determined off-site before beginning the survey, in which case the PIC may be unnecessary for the survey operation)

- Ludlum Model 19 micro-R meter (Figure 4)

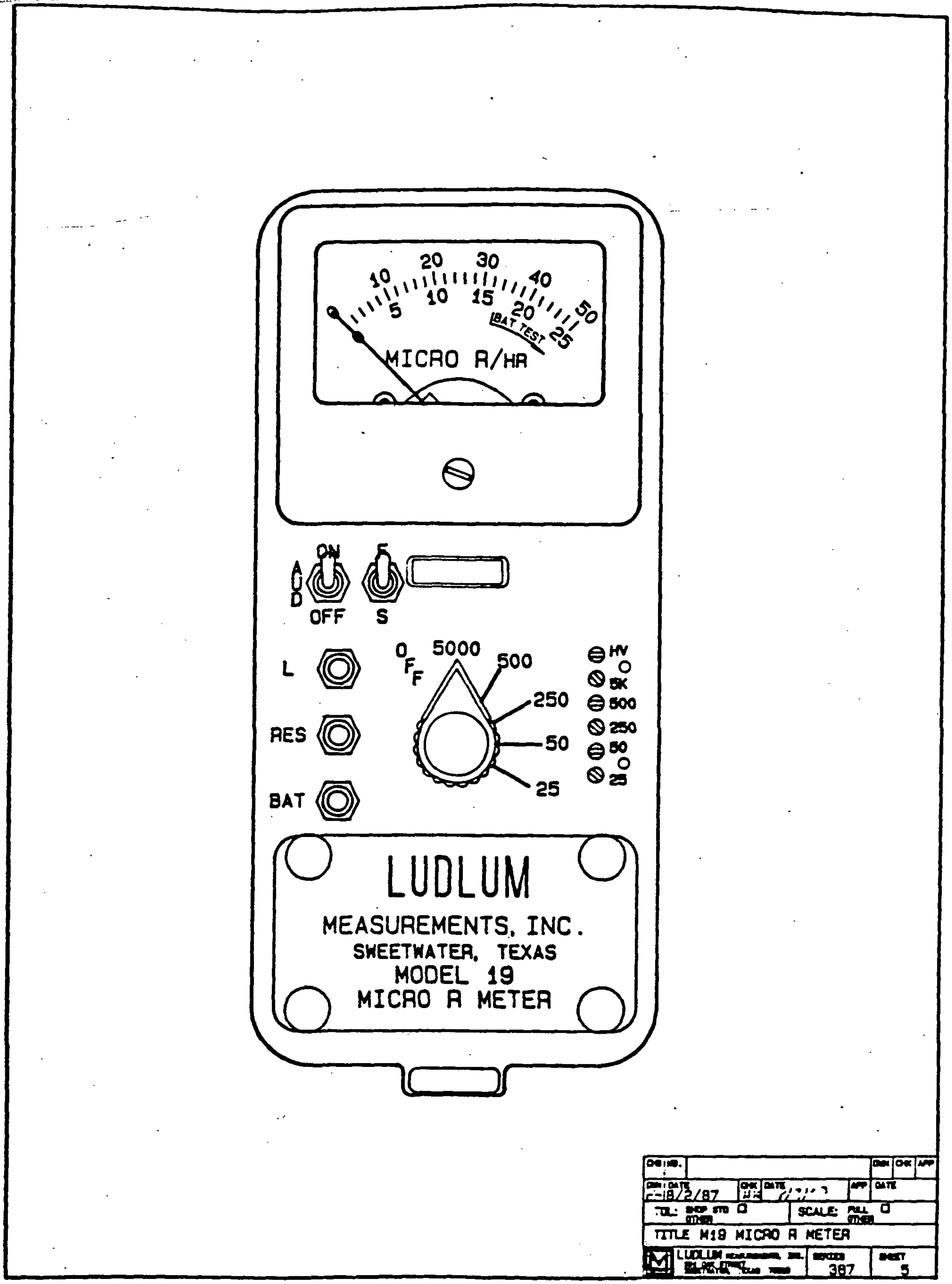


FIGURE 4. Ludlum Model 19 Micro-R Meter.

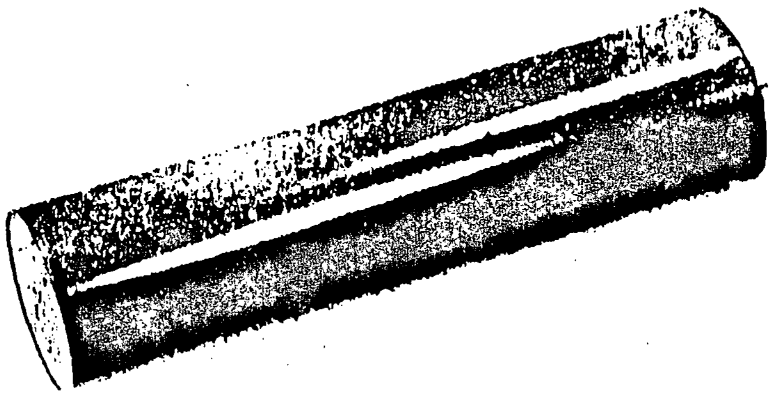
- Ludlum Model 44-10 sodium iodide (NaI) detector or equivalent (Figure 5)
- Cs-137 gamma check source (662 keV)
- Field logbook
- Gamma Ray Count Rate Data Forms

Pre-survey procedures to be completed before beginning the survey of the treatment plant building include the following:

- Obtain permission for property access.
- Review site-specific Health and Safety Plan and any other site-specific documents and associated procedures.
- Gather and test all field equipment. Before entering the site, switch the scintillometer on and check the battery for adequate power. Switch it to the highest scale and perform an operational check of the instrument using the Cs-137 gamma check source, switching to lower scales, as necessary. This calibration check should be performed daily during use. Document the calibration on the Gamma Ray Count Rate Data Form (Figure 6). All equipment must be properly calibrated before use, and the calibration information maintained. The calibration information accompanying the instruments should be inspected to verify that each instrument has been properly calibrated.

After verifying the proper operation and calibration of the equipment, the following survey procedures should be followed.

- With the meter initially set on the lowest scale, walk through all areas and observe the exposure rate as indicated on the meter. Gamma exposure rates should be measured inside the treatment plant building around the inner perimeter of the building approximately 1 meter above the floor, around piping and valves, and at regular height intervals (approximately 1 meter) around each of the three GAC adsorption units.
- The meter reading will fluctuate slightly with natural variations in background radiation levels. However, any sustained or obviously elevated readings should be investigated by thoroughly searching the area with the meter and taking several (at least 3) readings to



MODEL 44-10
GAMMA SCINTILLATOR
INDICATED USE: Low level Gamma detection
DETECTOR: 5.1 (2") thick by 5.1 (2") diameter NaI (TI)
TUBE: 5 (2") diameter photomultiplier
EFFICIENCY: Approximately 900,000 CPM/mR/hr for Cs-137 Gamma
SIZE: 27.9 (11")L by 6.7 (2.625") diameter
WEIGHT: 1.1 (2.5 pounds)

FIGURE 5. Ludlum Model 44-10 Gamma Scintillator.

GAMMA RAY COUNT RATE DATA

(USING SCINTILLOMETER) PAGE 1 OF ____

FACILITY CODE ________________ FIELD REP ________________

LOGGER CODE ________________ **LOG DATE** ________________

ACCEPTANCE CODE ________________ SITE AREA CORRELATION NO ________

RATEMETER/SCALER MANUFACTURER ________________ VOLTAGE ________

MODEL NO ________ SERIAL NO ________ CALIBRATION DATE ________

WINDOW OUT THRESHOLD ________ BATTERY ________

PROBE MANUFACTURER ________________

MODEL NO ________ SERIAL NO ________ CALIBRATION DATE ________

SOURCE CHECK DATE/TIME ________________

LOCATION	**COORDINATES (FT)**		METER READING (CPM)		EXPOSURE RATE (μ R/hr)	
ID	**NORTH**	**EAST**	SURFACE	3 FT	SURFACE	3 FT

ACCEPTANCE CODES: A-ACCEPTABLE R-RECONNAISSANCE U-UNACCEPTABLE N-NOT DETERMINED

COMPLETE BOLDED DATA FOR ENTRY INTO TIMS
SED-100 (2/88)

________________ FORM COMPLETED BY/DATE

________________ TECHNICAL REVIEWER/DATE

FIGURE 6. Gamma Ray Count Rate Data Form.

confirm elevated levels. Particular notice should be taken of any readings within 10% of the 2 mR/hour action level.

- If the initial survey indicates activity levels significantly above background, then a systematic survey should be performed based on a uniform sampling grid (e.g., 1 meter grid) established within the treatment plant building.
- Record all readings and locations on the Gamma Ray Count Rate Data Form (Figure 6), and record all notes in a field logbook.

Procedures to be performed after completion of the survey include the following:

- Turn all instruments off.
- Recharge, replace or remove batteries, as necessary.
- Return all instruments and check sources to secure storage areas.
- File all field forms and field logbooks.

Influent/Effluent Water Sampling

Samples of the influent water and the effluent water from each of the three adsorption units are currently collected on a monthly basis and submitted to the NJDEP and Calgon Corporation for analysis for TCE and PCE. Water samples may be collected from these existing sampling ports, sealed in airtight containers, and sent to EPA's Eastern Environmental Radiation Facility (EERF) in Montgomery, Alabama for detailed analysis of radon (and other radionuclide) concentrations. This radon sampling should be coordinated with the EERF to ensure that appropriate containers and procedures are used, and to schedule the desired analyses.

Sampling of Spent Carbon

If the gamma exposure rate survey indicates elevated exposure rates (e.g., within 10% of the 2 mR/hour action level) at the outer surface of the GAC adsorption units, it may be desirable to take samples of the carbon from one or more of the units for detailed analysis. Each treatment unit is configured with removable flanges in the top surface (see Figure 3) through which a core could be taken; however, this sampling would have to be performed while the unit was out of service and the physical configuration of the units within the treatment plant building would make this sampling difficult. A more convenient point for sampling may be from the Calgon hopper trailer used for carbon changeout. At the time of changeout (approximately once per year), the spent carbon in the three treatment units is pumped out into an empty hopper trailer in slurry form; then fresh carbon from another hopper is pumped into the treatment vessels. Manways in the top of the hopper trailer (Figure 7) would permit access for withdrawing samples; however, the spatial information on the vertical and horizontal variations in radionuclide concentrations possibly obtained from the core samples would be lost. At least two 1-gallon samples of the spent carbon should be removed, sealed in airtight containers, and sent to the EERF for detailed radionuclide analysis. Again, this sampling should be coordinated with the EERF to ensure the use of approved sample containers and procedures, and to schedule the desired sample analyses.

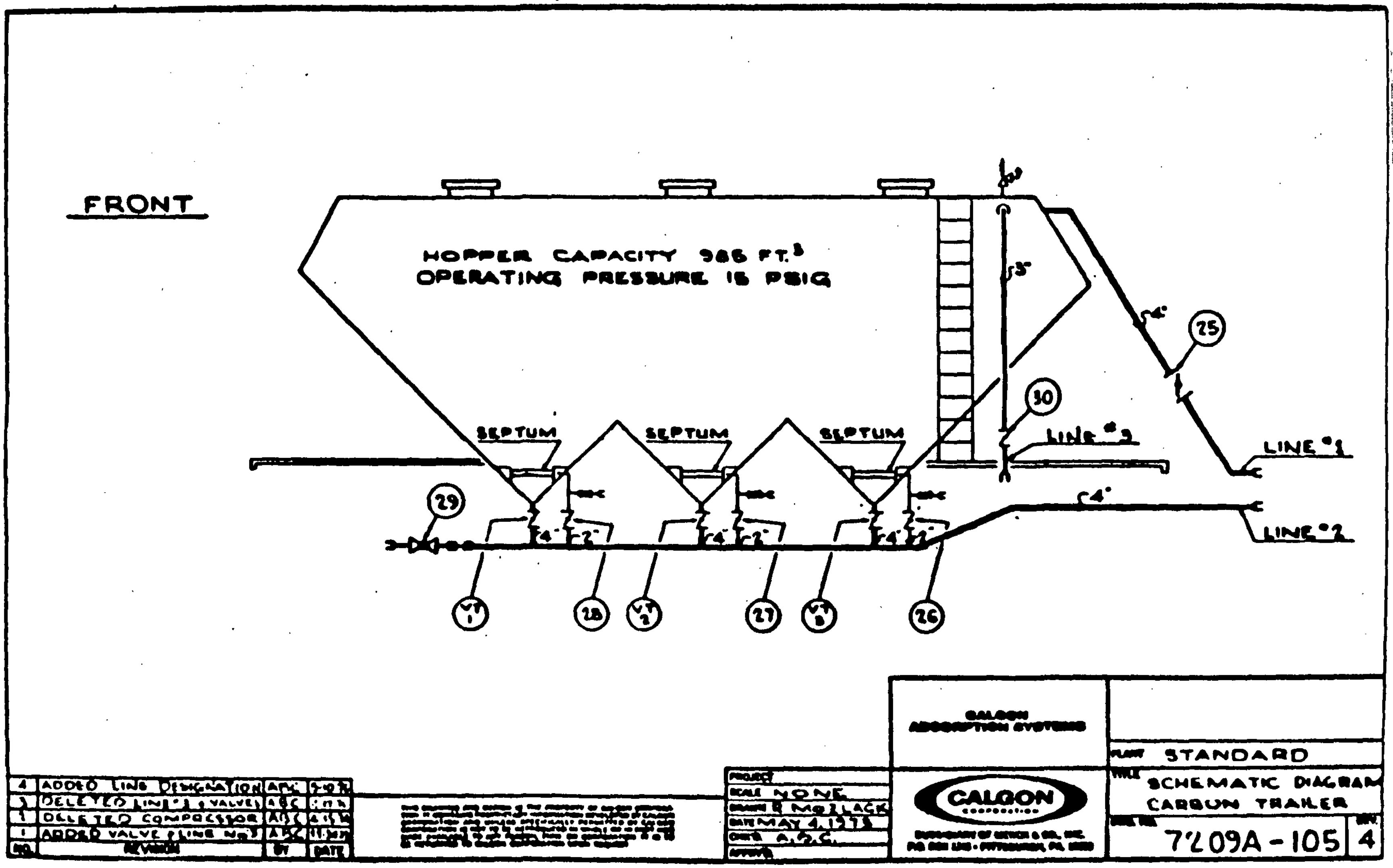


FIGURE 7. Schematic diagram of Calgon Corp. GAC hopper trailer.

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References

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EERF Eastern Environmental Radiation Facility, U.S. Environmental Protection Agency, Montgomery, AL, data-base of measured concentrations of radon/radium/uranium in U.S. water systems.

Ma88 John Magee, State of New Jersey, Department of Environmental Protection, Division of Hazardous Site Mitigation, personal communication, July 20, 1988 (re: NJDER Examining Engineer's Report for Rockaway Borough site).

NIRS National Inorganics and Radionuclides Study, U.S. Environmental Protection Agency, Cincinnati, OH, data-base of measured concentrations of radon/radium/uranium in 1000 U.S. drinking water systems.

Pa87 Bahman Parsa, State of New Jersey Department of Environmental Protection, 1987, letter dated 3 June 1987 to T. Horton USEPA/EERF regarding Rn-222 concentrations measured in New Jersey drinking water.

Ro88 Joe Rossi, Municipal Engineer, Borough of Rockaway, Morris County, NJ, personal communication.

USEPA86 U.S. Environmental Protection Agency, 1986, "Superfund Record of Decision: Rockaway Borough Well Field, NJ," EPA/ROD/RO2-86/034.